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Docket No.: 49959-013

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

: **RESPONSE UNDER 37 CFR 1.116**

Ariel BEN-PORATH, et al.

: **EXPEDITED PROCEDURE**

Serial No.: 09/111,454

: Customer Number: 20277

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:
: Examiner: V. Bali

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Technology Center 2600

For: AUTOMATIC DEFECT CLASSIFICATION WITH INVARIANT CORE CLASSES

RESPONSE UNDER 37 CFR 1.116

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The following Remarks are submitted in response to the Final Office Action mailed May 24, 2004.

Claims 1-3, 6-20, 23-38 and 40-60 are pending in the application. Claims 9-17, 26-34 and 49-60 have been withdrawn from consideration.

In the Office Action, claims 1-3, 6-8, 18-20, 23-25, 37, 38, and 40-42 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 6,047,083 (Mizuno) in view of U.S. Patent 5,814,829 (Broude) and further in view of U.S. Patent 4,849,901 (Shimizu). Claims 35, 36 and 43-45 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Mizuno, Broude and Shimizu and further in view of U.S. Patent 5,591,971 (Shahar). Claim 46 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Mizuno in view of Shahar. Claim 47 was rejected

under 35 U.S.C. § 103(a) as being unpatentable over Mizuno in view of Shahar and further in view of U.S. Patent 5,801,965 (Takagi). Claim 48 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Mizuno and Shahar and further in view of U.S. Patent 5,960,106 (Tsuchiya). These rejections are respectfully traversed. Applicants respectfully request reconsideration and allowance of the claims in view of the following arguments.

The present invention relates to a method and apparatus for automatically classifying a defect on the surface of a semiconductor wafer into one of a plurality of invariant (i.e., standardized) core classes after inspection with, for example, a scanning electron microscope (SEM) and/or an optical inspection tool. The invariant core classes of defects can include a missing pattern on the surface, an extra pattern on the surface, a deformed pattern on the surface, a particle on the surface, a particle embedded in the surface, a particle and a deformed pattern on the surface, or craters and microscratches on the surface. The defect may be further classified into one or more subclasses of one of the invariant core classes, the subclasses being of arbitrarily defined defects defined by the user or preprogrammed in the apparatus. As the defects are classified, counts are maintained of the number of occurrences of each type of defect, and an alarm is raised if the defect count in a particular class exceeds a predetermined level.

Defects are accurately and reliably classified and monitored using the present apparatus and methodology, thereby enabling early detection and cure of processing problems. All defects are classified by the present methodology into one of a predetermined number of invariant core classes. The present invention thereby provides a standardized set of defect classes, which are readily correlated to the causes of defects. Moreover, since the defect classes are standardized rather than user-specific, the present apparatus and methodology requires a lesser number of

defect images to be obtained for each defect class prior to becoming operational. Consequently, the present invention can be easily utilized during start-up and ramp-up of a production line.

Regarding the obviousness rejection of independent claims 1, 18, and 37 based on Mizuno, Broude and Shimizu, it would not have been obvious to combine Mizuno and Broude as the Examiner suggests. It is contended in the Office Action that it would have been obvious to modify Mizuno's defect inspection and classification technique by introducing Broude's teaching of counting defects and generating a signal when a threshold number of defects of a particular size and/or at a particular location are found, to thereby yield the invention of claims 1, 18 and 37.

Applicants disagree, and submit that the Examiner has not provided an objective teaching that would have motivated a skilled artisan to incorporate Broude's teaching into Mizuno's system, because none exists. The goal of Mizuno's system is very different from that of Broude, and would not benefit from adding Broude's defect counting and signal-generating functions. Conversely, Broude's system would not gain improved functionality by incorporating Mizuno's teachings.

The purpose of Mizuno's semiconductor device defect classification system is to determine a probability of defects being or becoming "killer defects" (i.e., defects causing failure of the device). After classifying defects, Mizuno's methodology determines the percentage chance of failure (called the "degree of criticalness") of the inspected device for each defect, then calculates the probability of failure for the device using weight coefficients. The procedure further includes mapping probable failing devices on a wafer map. This technique is explained in Mizuno at, for example, col. 7, line 45 to col. 8, line 15. By identifying killer defects, Mizuno claims to decrease defects affecting the product yield, and thereby improve the product yield.

Broude relates to a photolithographic mask (or "reticle") inspection system wherein when a threshold number of reticle defects of a particular size at a particular location is exceeded, the inspection is interrupted and the operator informed, so that time is not wasted continuing inspection of a low-quality reticle (see, e.g., col. 5, lines 47-67). Broude's system is for efficiently discovering and rejecting reticles that do not meet predetermined quality standards.

Mizuno's purposes would not be furthered by Broude's defect counting and signaling technique. Broude's approach to inspection is much different (and less sophisticated) than Mizuno's, and is used in a different context. Broude's technique is for inspecting completed masks before they are used in production to weed out low-quality masks (i.e., a "go -no go" test). In contrast, Mizuno predicts product yield during production by using defect feature data from the inspection process to improve its inspection process and yield, by correlating defect feature data with the chance of such defect features causing failure. None of these functions are performed by Broude's inspection methodology, and none of Mizuno's goals would be served by modifying it with Broude's defect counting and display/inspection shutdown technique. Moreover, there is no objective teaching in Mizuno's yield prediction methodology relating to Broude's functions of defect counting resulting in inspection shutdown, or vice versa. Therefore, a skilled artisan would not have been motivated to add Broude's defect counting and display/inspection shutdown technique to Mizuno's inspection system to yield the invention of independent claims 1, 18 and 37.

As pointed out at page 5 of the Office Action, to establish obviousness, the Examiner must provide an objective teaching in the art that would have motivated a skilled artisan to combine or modify the references to yield the claimed invention. It is contended by the Examiner that a skilled artisan would have been motivated to incorporate Broude's counting and

display/shutdown features into Mizuno's inspection system to generate a signal to stop the process to get a better yield (see paragraph bridging pages 6-7). However, there is no support in either reference for this contention. *See, In re Lee*, 277 F.3d 1338, 1342-44 (Fed.Cir. 2002)(discussing the importance of relying on objective evidence and making specific factual findings with respect to the motivation to combine references).

As discussed above, Broude teaches counting defects, displaying the results and shutting down the inspection process to reject a low-quality reticle, not to improve or predict the yield of the reticle manufacturing process (or of any other manufacturing process). Broude's process is not used for in-process inspection, where yield is an issue, but rather is used after completion of a reticle and before production using the reticle begins.

Moreover, stopping or slowing down the process to improve yield is not taught or even suggested as a desirable action in Mizuno. Mizuno arguably teaches away from such action by teaching the use of its inspection results to determine the severity of defects, thereby improving failure prediction and enabling yield improvements. Mizuno's production line does not need to be slowed or stopped, as suggested in the Office Action, since Mizuno teaches an alternative technique for dealing with defective products; i.e., accurate identification of potentially defective devices. Such action would defeat the purpose of Mizuno's automated inspection/classification/killer defect identification system. It is well-established that if a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900 (Fed.Cir. 1984); *In re Ratti*, 270 F.2d 810 (CCPA 1959)(If a proposed modification or combination would change the principle of operation of the prior art

invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious); MPEP § 2143.01.

It is further pointed out in the Office Action (see page 5) that a conclusion of obviousness should take into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and should not include knowledge gleaned only from the applicant's disclosure. However, the motivation to combine the cited references offered in the Office Action (i.e., to stop the process to get a better yield) is found *only* in the disclosure of the present application. As discussed immediately above, neither Mizuno nor Broude teach or suggest this. Furthermore, the tertiary Shimizu reference does not furnish any such objective teaching either. Indeed, it is not even alleged in the Office Action that Shimizu furnishes such a teaching. The prior art does not suggest the desirability of the claimed invention. Thus, the Examiner is employing improper hindsight here, using the Applicants' disclosure of their motivation for making the invention against them.

The statement in the Office Action offered to show motivation to combine Mizuno and Broude with Shimizu to yield the claimed invention is speculative, and cannot support a rejection under 35 U.S.C. § 103.

Consequently, independent claims 1, 18 and 37 are patentable, as are claims 2, 3, 6, 7, 8, 18-20, 23-25, 37, 38 and 40-42, which depend from claims 1, 18 and 37.

Regarding the obviousness rejection of dependent claims 35, 36 and 43-45 based on Mizuno, Broude, Shimizu and Shahar, the Shahar reference does not furnish the necessary motivation to combine Mizuno, Broude and Shimizu to yield the computer readable medium of independent claim 18, from which claims 35 and 36 depend, or the apparatus of independent claim 37, from which claims 43-45 depend.

Consequently, claims 35, 36 and 43-45 are patentable.

Regarding the rejection of independent claim 46 based on Mizuno and Shahar, neither cited reference teaches or suggests the important step of imaging with both an SEM and an optical imager. It is admitted in the Office Action that Mizuno does not disclose the claimed combination of SEM and optical imaging. Shahar teaches SEM imaging only. Applicants note that Shahar's detectors 240, 250 are explicitly described as Everton Thorenly detectors (see col. 5:15-21), which are well-known in the art as electron detectors, not optical detectors as contended in the Office Action. The Office Action's contention, at page 7, that electrons are the emitted light that is sensed by sensors 240, 250, flies in the face of the plain meanings of the terms "optical" and "SEM" as used in this art by equating them to each other, and is therefore improper. One skilled in the art would most certainly appreciate that there is a difference between optical imaging and SEM imaging, and would further appreciate that the Everton Thorenly detectors 240, 250 that are parts of the SEM of Shahar, are not optical sensors. Since neither reference teaches or suggests the above-discussed SEM/optical imaging step of claim 46, any combination of Mizuno and Shahar, however made, would still be missing this step. Moreover, it would not have been obvious to add this step to any Mizuno/Shahar combination. There is no objective teaching offered to support the contention in the Office Action that a skilled artisan would have been motivated to modify Mizuno's apparatus to obtain a better perspective of the image. This contention is speculative and cannot support an obviousness rejection.

Consequently, claim 46 is patentable.

Regarding the obviousness rejection of dependent claim 47 based on Mizuno, Shahar and Takagi, the Takagi reference does not furnish a teaching or suggestion of the SEM/optical

imaging step of claim 46, from which claim 47 depends, missing from Mizuno and Shahar. Therefore, any combination of Mizuno, Shahar and Takagi, however made, would still be missing this step, and it would not have been obvious to add this step to any Mizuno/Shahar/Takagi combination.

Regarding the obviousness rejection of dependent claim 48 based on Mizuno, Shahar and Tsuchiya, the Tsuchiya reference does not furnish a teaching or suggestion of the important step of imaging with both an SEM and an optical imager of independent claim 46, from which claim 48 depends, missing from Mizuno and Shahar. Thus, any combination of Mizuno, Shahar and Tsuchiya, however made, would still be missing this step, and it would not have been obvious to add this step to any Mizuno/Shahar/Tsuchiya combination.

Consequently, claim 48 is patentable.

Reconsideration and withdrawal of the rejection of claims 1-3, 6-8, 18-20, 23-25, 35-38 and 40-48 under 35 U.S.C. §103(a) are respectfully requested.

Accordingly, it is believed that all pending claims are now in condition for allowance. Applicant therefore respectfully requests an early and favorable reconsideration and allowance of this application. If there are any outstanding issues which might be resolved by an interview or an Examiner's amendment, the Examiner is invited to call Applicant's representative at the telephone number shown below.

09/111,454

To the extent necessary, if any, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

MCDERMOTT WILL & EMERY LLP

A handwritten signature in black ink, appearing to read "Michael A. Messina".

Michael A. Messina

Registration No. 33,424

600 13th Street, N.W.
Washington, DC 20005-3096
(202) 756-8000 MAM:mcm
Facsimile: (202) 756-8087
Date: July 26, 2004